Enhancing In-Flight Transoceanic Communications Using Swift-64 Packet Mode Service

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Introduction

- WINCOMM
  - Develop advanced communications technologies
  - Timely and efficient dissemination of weather information
- Transoceanic Scenario
  - Focus on international flights over the ocean
  - Communications are limited to HF spectrum
  - Minimal enroute weather information collection and dissemination
  - Flight testing by mid-2005
- ***Overall Goal:*** *Employ satellite-based communications to provide weather information to the cockpit using packet mode delivery service and efficiently share the same link with cabin data.*

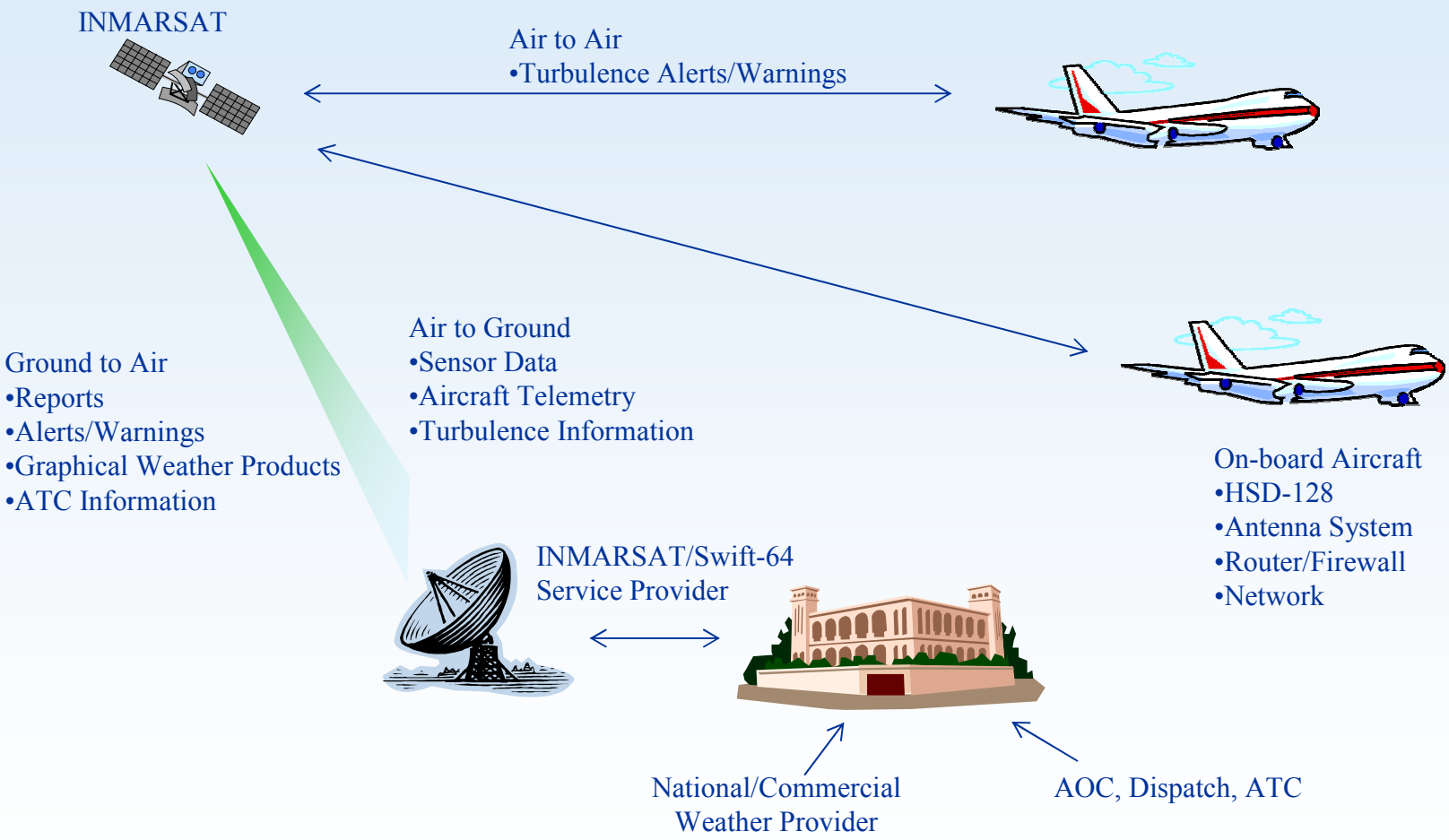
Updating the Communications Architecture

- What are the current capabilities -
  - Communications via circuit-switching
    - Dedicated communications path and allocated bandwidth
  - Existing data links transport small, low volume messages.
- Future Capabilities
  - Convert existing systems to use satellite communications and packet-mode service.
    - Use commercially available services and standard protocols.
  - Efficiently and effectively separate cabin and cockpit data from shared link.
  - Provide advanced data products.

Data Products

- Turbulence Data
  - Disseminate to other aircraft or ground.
  - Receive and display warnings to the cockpit from other aircraft.
- Graphical Weather Products
  - Receive, process and display weather products.
- Cockpit Warnings and Alerts
  - Receive, process and display warning and alerts.
- Air Traffic Control (ATC) Data.
  - Receive and process ATC information from ground stations.
  - Verify that ATC information can be transferred reliablely and securely.

Transocean Scenario Architecture



Glenn Research Center

at Lewis Field

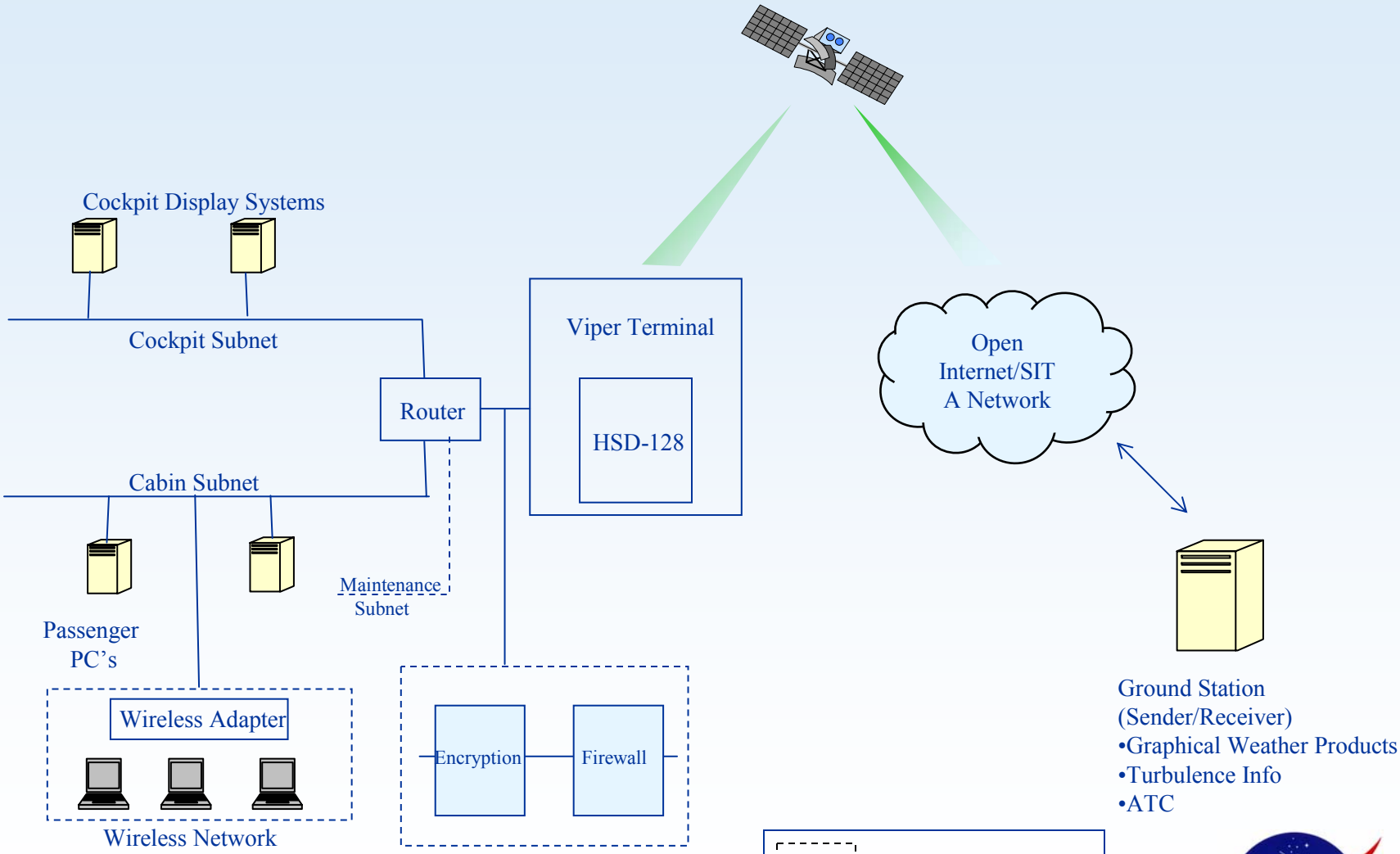
Research Issues

- Quality of Service (QoS)
  - Cockpit data must maintain a higher level of priority than the cabin data
    - Differentiate between cabin data, weather data or ATC data.
    - Determine changes to router OS for QoS and determine how effectively the OS handles QoS.
- Link Availability
  - Must maintain communications with the cockpit at all times.
    - Determine if INMARSAT/Swift-64 coverage is extensive enough to cover the majority of the flight patterns.
    - Determine if ground networks be relied upon for cheaper content delivery.
- Security
  - Protect the shared link from unauthorized users.
    - Apply lessons learned from the terrestrial Internet.
    - Application of security devices (e.g., encryptors, VPN, firewalls) to the on-board network.

Research Benefits

- Reduce Costs
  - IP-based Protocols
    - Take advantage of large body of researchers.
  - Commercial Services (SITA and INMARSAT)
    - Packet Mode Service – Pay by amount of data transferred.
- Efficient Bandwidth Usage
  - Using Packet Mode Services
    - No Allocation of the Data Link.
  - Multiple Users can Share the same Link.
- Data Integrity and Reliability
  - Validate Data via Built-in Checksums
    - 16-bit Checksums may not be sufficient for ATC data.
  - Reliability via Acknowledgement Schemes
- Security
  - Leverage Terrestrial Security Scheme
    - Encryption, VPNs, IPSec, etc.

Testbed Architecture



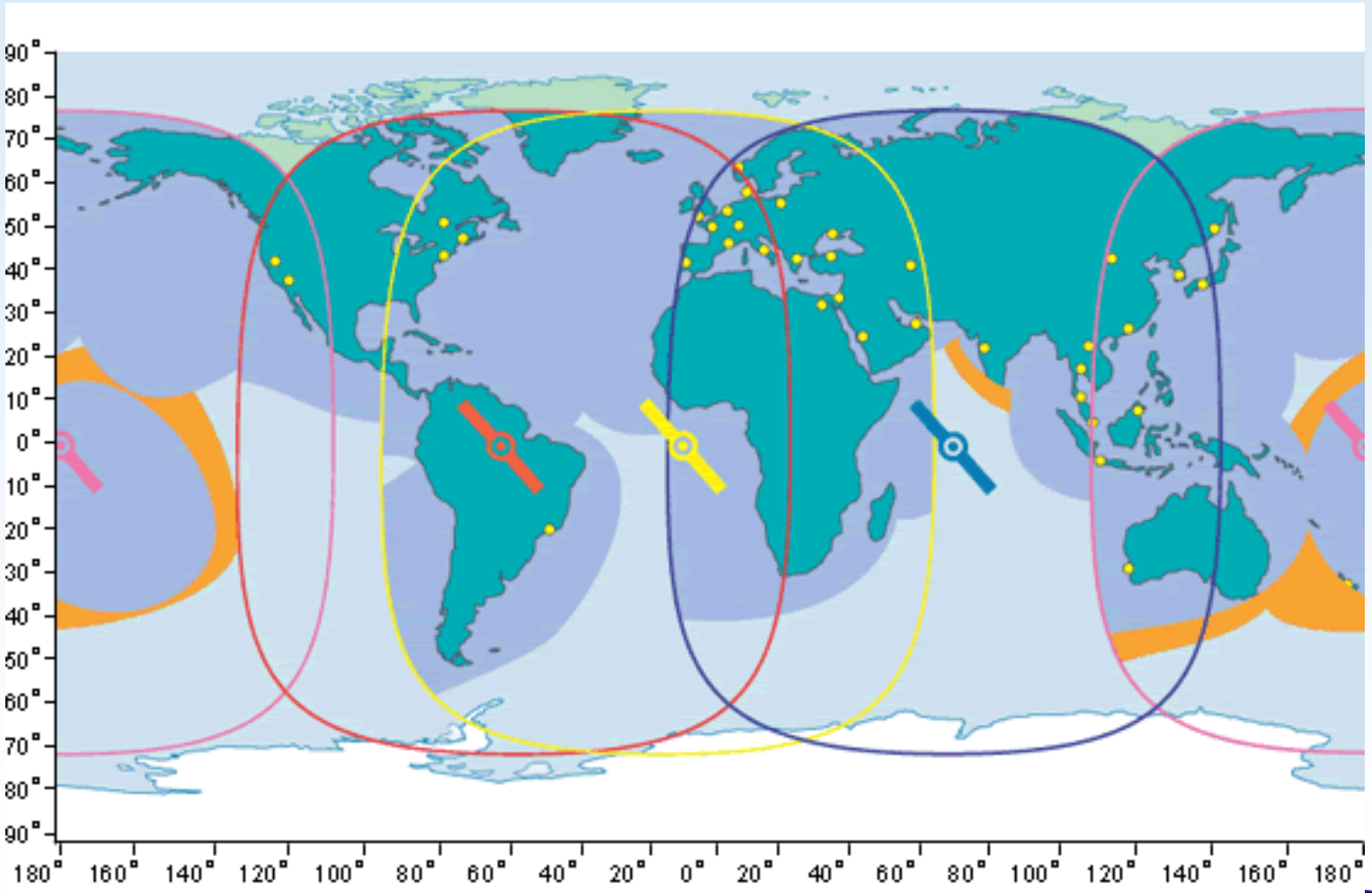
High-Speed-Data SATCOM Transceiver

- HSD-128 – Aeronautical High Speed Data Terminal
  - 2 – 64 kbps dual channel capacity for voice or data
    - Can be bonded together for 128 kbps
  - Interfaces
    - ISDN, 10-Base-T Ethernet and RS-232
  - Operates with any ARINC 741 compliant High-Gain Antenna
- Viper II
  - HSD-128 in a ruggedized, modular platform
  - Ideal for roll-on/roll-off airborne pallet for rapid deployment
  - All interfaces and configuration pins are accessible from rear panel.

Commercial Services

- INMARSAT
  - Worldwide network of ground stations and satellites.
  - Swift-64
    - High-performance in-flight communications service.
  - Two types of services
    - Mobile ISDN
    - Mobile Packet Data Services (MPDS)
- SITA
  - Provides INMARSAT/Swift-64 Service
  - Extensive ground network
  - Partner of INMARSAT
- EMS
  - Develops and markets the HSD-128 transceiver.

INMARSAT Coverage



Approach

- Phase I – Investigation and Design
  - Requirements Definition
  - Design Candidate Architectures
  - Research QoS and Security Issues
  - Setup Testbed
- Phase II – Implementation
  - Implement the Architectures in Testbed
  - Implement Parameter Changes
    - QoS
    - Security
- Phase III – Flight Testing
  - Installed on NASA-owned aircraft
    - 757 stationed at Langley Research Center (LaRC)
  - Investigate New INMARSAT-4 Satellites

Conclusion

- Improve communications during transoceanic flights
  - Using packet mode service
  - Differentiate between cabin and cockpit data
  - Improved weather data products
- Validation and Testing
  - Using actual equipment in testbed
  - Flight Testing in mid-05
- Improved data products
  - Provide graphical weather products
  - Improved Turbulence Information
  - Cockpit Warnings/Alerts
  - Air Traffic Control data

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Relevant Publications

"Enhancing In-Flight Transoceanic Communications Using Swift-64 Packet Mode Service"